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LISTS OF SPECIES

Bats (Mammalia: Chiroptera) from Guarulhos, state of São Paulo, Brazil

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ABSTRACT: The present study provides a record of the bat fauna captured in Guarulhos, state of São Paulo, Brazil, between February and November 2011. The capture sessions were carried out using mist nets set on trails, around and above streams and lakes, near built areas and around livestock. After a total effort of 26,208 m^2.h, we recorded 17 bat species belonging to Phyllostomidae (13 species), Vespertilionidae (3) and Molossidae (1). *Sturnira lilium* (73 captures), *Artibeus fimbriatus* (69), and *A. lituratus* (59) were the most abundant species, corresponding to 57.8% of all captures. Some information about shelters was also commented. This paper is the first to report *Molossops neglectus* for Guarulhos.

INTRODUCTION

During the last decades, Guarulhos had a population growth rate higher than the average of its region and higher even than that of the city of São Paulo (state capital). As a result of the urban expansion, the native vegetation was removed, giving way to commercial, industrial, and service activities (Oliveira and Andrade 2008). In spite of this, several forest fragments remained in Guarulhos, most of which located in the north and northeastern regions of the municipality (33% of the fragments). Thus, these areas also comprise the greatest biodiversity found in Guarulhos (Andrade *et al*. 2008).

Although many faunal inventories have been carried out in southeastern Brazil, in Guarulhos they are still scarce. The latest initiative to counteract this scarcity was the project "Guarulhos has Biodiversity", which started officially in 2007 (Diário Oficial do Município de Guarulhos N° 042/2007). Our study on the bat fauna of Guarulhos is part of this project.

MATERIAL AND METHODS

Study area

Guarulhos is located in the transition between tropical and temperate zones; it has a mesothermal humid climate, with two or three dry months in the winter. Annual mean temperature ranges from 15° to 24°C and rainfall ranges from 1,250 to 1,500 mm. Serra do Itaberaba is the highest point located at northeastern Guarulhos, with 1,422 m of altitude, and preserves most of the municipality vegetation, described as Ombrophylous Dense Forest by Andrade *et al.* (2008).

Sampling sites

The present study was carried out in 10 different sites (Figure 1) in Serra do Itaberaba, Guarulhos, state of São Paulo, around the State Park of Itaberaba, created in 2010. Most of the sampling sites were private properties with animal-raising areas surrounded by fragments of Atlantic Forest. The sites were the following: (A) a private property situated on a hill, along a stream with riparian vegetation, and some domestic animals (chickens, pigs and cows) (23°20' S, 46°23' W); (B) a fishing farm with artificial lakes for fishing activity, fish ponds, streams with riparian vegetation, a restaurant, and the owner's house (23°20' S, 46°24' W); (C) a farm with forest fragments, a stream, ponds, animal-raising such as chickens, cattle, sheep, goats, ostrich, and dogs (23°20' S, 46°24' W); (D) a forest park (Horto Florestal de Guarulhos) with fragments of Atlantic Forest, greenhouses, and seedlings (23°22' S, 46°23' W); (E) an area with a historic mansion called "Candinhas House" surrounded by forest fragments and streams with riparian vegetation (23°23' S, 46°28' W); (F) a private property with a hennery, an artificial lake, a stream with riparian vegetation, and the owner's residence (23°20' S, 46°24' W); (G) a private property that was formerly used as a recreational area, with open spaces and trails through the Atlantic Forest and a tunnel of groundwater that flows into an artificial lake (23°21' S, 46°24' W); (H) a crops farm with a hennery, forest fragments, swamps, and abandoned buildings (23°20' S, 46°24' W); (I) an area with a hennery, a corral, some goats and turkeys, an abandoned house, and other uninhabited buildings surrounded by forest (23°18' S, 46°22' W); and (J) a green area with trails, artificial lakes, and forest fragments owned by a beverage company (23°18' S, 46°23' W).

Capture Sessions

The bat sampling was conducted during 18 nights, from February to November 2011, using six to nine mist nets each night. The mist nets size ranged from 7x3 m

to 12x3 m. They were opened during the first six hours after sunset, 0.2 m to 3.0 m high, in trails at the border and inside forest fragments, around and above streams and lakes, and near building areas, depending on the site options. At places with livestock, some nets were set up around the animals in order to capture vampire bats.

Captured bats were identified, measured, and released, except for one individual of each species by sampling night. These specimens were deposited as voucher in the Vertebrate Collection of Department of Zoology, Institute of Biosciences, UNESP, Botucatu *campus* (Appendix 1). Individuals were identified according to Vizotto and Taddei (1973), Gregorin and Taddei (2002), LaVal (1973), and other references (Taddei *et al.* 1998; Gregorin *et al.* 2004; Bernardi *et al.* 2007; Araújo and Langguth 2010). The capture and collection of all bats reported here were conducted under the permanent license of Wilson Uieda (IBAMA nº 23151-1).

Results and Discussion

We carried out 108 sampling hours, comprising a total effort of 26,208 m^2.h (Straube and Bianconi 2002). A total of 17 bat species of three families (Phyllostomidae, Vespertilionidae and Molossidae) were recorded in 348 captures (Table 1). Phyllostomidae was the richest group with 13 species, wich corroborates the majority of the bat fauna surveys of the Atlantic Forest (Reis *et al.* 2000; Falcão *et al.* 2003; Bianconi *et al.* 2004; Bordignon 2006; Dias and Peracchi 2008) that used mist nets as the main sampling methodology. Mist net is an useful method for sampling phyllostomids and other bats that forage in the understory (Kalko 1998; Straube and Bianconi 2002).

Most captured species belong to Stenodermatinae (Phyllostomidae). This group has 12 genera and 33 species with occurrence in Brazil (Zortéa 2007). Of these, six (*Artibeus lituratus*, *A. fimbriatus*, *Pygoderma bilabiatum*, *Platyrrhinus lineatus*, *Sturnira lilium*, and *Carollia perspicillata*) were recorded by us in Serra do Itaberaba.

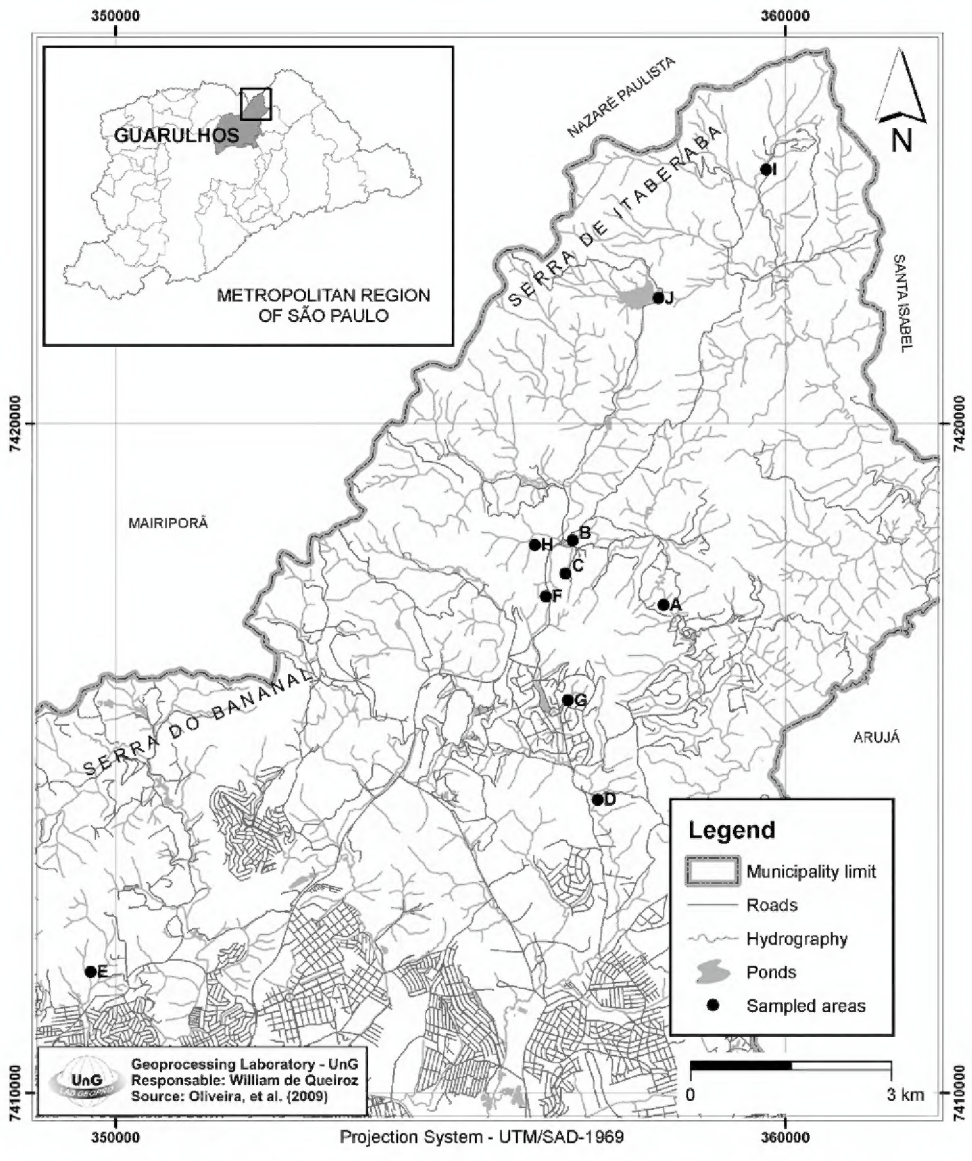

Figure 1. Map of the northeastern region of the municipality of Guarulhos, state of São Paulo, showing the Serra do Itaberaba and the location of the 10 sites (A to J) sampled for bats (see text for details).

Similar to other inventories in secondary forests (Falcão *et al.* 2003; Passos *et al.* 2003; Zanon and Reis 2007), our study showed that *S. lilium* (73 captures), *A. fimbriatus* (69), and *A. lituratus* (59) were the most abundant species, corresponding to 57.8% of all individuals captured. The former species is common in open and secondary growth areas and feeds on a variety of fruits, especially pioneer plants (Bredt *et al*. 2012), as well as on polen and insects (Gardner 1977). According to Fleming (1988), *S. lilium* could be classified as an understory frugivore. The two other bat species feed mainly on Moraceae (especially *Ficus* spp.) and Urticaceae (Mikich 2002; Passos *et al.* 2003; Passos and Graciolli 2004). The families Urticaceae and Moraceae have several pioneer species, such as *Cecropia pachystachya* and *Ficus dendrocida* (Lorenzi 1992; 1998).

According to Zortéa (2003), the three species of glossophagine bats captured in Guarulhos (Table 1) are the most common species of this subfamily and, in general, few species of this group have been found in sympatry (Passos *et al.* 2003; Nogueira *et al.* 2007). The largest number of *A. caudifer* (N= 47) in our study is a result of their netting while emerging from the shelter. A group of 12 *A. caudifer* was captured while emerging from the Candinhas House, where these individuals were harbored. Two *G. soricina* also emerged from that shelter. This nectar feeding bat has been usually found in Brazilian urban areas (Bredt and Uieda 1996; Silva *et al.* 1996; De Knegt *et al.* 2005; Uieda and Chaves 2005; Bredt *et al.* 2012), where they harbor in attics and basements. On the other hand, *A. caudifer* is more adapted to medium and large forest fragments (Reis *et al.* 2003), as is the case of regions surrounding the Serra do Itaberaba.

The phyllostomines *Mimon bennettii* and *Micronycteris megalotis* were very scarce in our samples (Table 1), and they were recorded only during the dry season (May, July and August). Just one individual of the former species was netted in Guarulhos (site D). Two individuals of *M. megalotis* were captured in two different Atlantic Forest fragments (sites C and G). These phyllostomines seem to be negatively affected by the process of forest fragmentation and are usually recorded in low numbers in fragmented landscapes (Reis *et al.* 2000; 2006; Dias *et al.* 2002).

Of the three species of vampire bat guild, two (*D. rotundus* and *D. ecaudata*) were captured in Serra do Itaberaba. The former, also known as the common vampire bat, feeds on the blood of cattle, horses, pigs, and even humans (Gardner 1977; Schneider *et al.* 2001; Gomes and Uieda 2004), whereas the second feeds on avian blood (Gardner 1977; Uieda *et al.* 1992). *D. rotundus* was netted on trails, at the outside of their shelters (a groundwater tunnel and an abandoned house), and around corrals. The hairy-legged vampire bat *D. ecaudata* was sampled in four of the sites (C, F, G and I) and was always netted near their food source (chickens) or their day roost. In one occasion, we observed two individuals of *D. ecaudata* while hanging on the chicken's tail and feeding on their cloacal region. The chickens were resting on the hennery perches at 0.5 m high (site I). This feeding behavior was previously cited

by Greenhall (1988), Uieda (1992), and Uieda *et al.* (1992).

In one of the properties sampled (site G), there was a groundwater tunnel underneath a trail. This tunnel was at least 100 m long, had four openings, was full of water at several points, and its walls consisted of overlapping rocks. Seven species (*D. rotundus, C. perspicillata, G. soricina*, *A. caudifer, S. lilium*, *A. lituratus*, and *A. fimbriatus*) were captured in the net set in front of the tunnel's entrance. We did not check if these species were roosting inside the tunnel, but in the literature only *D. rotundus* and *C. perspicillata* were frequently observed harboring in this type of day roost (Marques 1985; Gomes and Uieda 2004; Oliveira *et al.* 2009).

An abandoned house (site I) was also used as shelter by small groups of *D. rotundus* (three individuals), *D. ecaudata* (three), *C. perspicillata* (seven), and *A. caudifer* (nine). The vampire bats harbored in only one of the three rooms of the house, where their guano was accumulated on the floor. *Carollia perspicillata* and *A. caudifer* were roosting in the opposite room. All four species have been observed cohabiting caves of the valley of the Rio Ribeira, SP (Trajano 1985), and the first three were observed in cohabitation in caves in the Federal District, Central-Western Brazil (Bredt *et al.* 1999). Marques (1985) had recorded *C. perspicillata* and *A. caudifer* cohabiting manholes in Manaus, AM, northern Brazil.

Vespertilionidae was represented by three species in our samples. *Myotis nigricans* was more abundant than *M. albescens* and was netted during its low flights along trails, above ponds, and built areas. *Myotis albescens*, in turn, was only captured during low flights above ponds (artificial lakes in areas B and J). *Myotis nigricans* is frequently listed in bat inventories from different regions (e.g. Peracchi and Albuquerque 1993; Teixeira and Peracchi 1996; Dias *et al.* 2002; Uieda and Chaves 2005; Reis *et al.* 2006; Ortêncio-Filho and Reis 2009), although in a low number. On the other hand, *M. albescens* is scarcely recorded in bat surveys and little is known about its biology. Only one juvenile bat of *Histiotus velatus* was found fallen on the floor of an old and uninhabited house (site I). According to Bianconi and Pedro (2007), *H. velatus* can use different kinds of shelter such as attics, roofs, crevices in rocks, caves, and abandoned mines.

Molossid bats usually harbor in house roofs, attics, and building expansion joints (Bredt and Uieda 1996, Chaves and Sodré 2007, Quintela *et al.* 2011). Although some mist nets were set around houses and trees of an orchard, only one individual (not pregnant adult female) of *Molossops neglectus* was netted in the orchard. Except by the slightly smaller length of the forearm (34.6 mm) and the greatest length of the skull (15.1 mm), measurements of this specimen, including breadth of the braincase (8.3 mm), length of the maxillary toothrow (5.9 mm), and length of mandible (11.4 mm) are within the range described for the species (Gregorin and Taddei 2002; Gregorin *et al.* 2004; Bernardi *et al.* 2007). Diagnostic qualitative characters described by Gregorin *et al.* (2004) and Barquez *et al.* (1999; 2011), such as dark brown dorsal hairs with distinctly white bases, ears and membranes almost black, and separated and triangular ears were also observed in our specimen. *M. neglectus* was only recently recorded in Rio Grande do Sul (Bernardi *et al.* 2007), significantly expanding its known geographic distribution. The present study is the first to report this rare bat for Guarulhos, indicating that new species of bats can still be found at this municipality. Future works using different sampling methods should also improve our knowledge about the bat fauna of Guarulhos.

Table 1. Bat species captured in the municipality of Guarulhos, state of São Paulo, in 2011.

TAXON	NUMBER OF CAPTURES										
	A	B	C	D	E	F	G	H	I	J	TOTAL (%)
Family Phyllostomidae											
Mimon bennettii (Gray, 1838)				1							**1 (0.3)**
Micronycteris megalotis (Gray, 1842)			1				1				**2 (0.6)**
Artibeus fimbriatus Gray, 1838	4	3	5	7	8	21	16	2	1	2	**69 (19.8)**
Artibeus lituratus (Olfers, 1818)	5		4	9	7	3	26	1	4		**59 (17.0)**
Pygoderma bilabiatum (Wagner, 1843)	1			1					1		**3 (0.9)**
Platyrrhinus lineatus (É. Geoffroy, 1810)					1	1					**2 (0.6)**
Sturnira lilium (É. Geoffroy, 1810)	11	2	3	6	7	7	24	5	8		**73 (21.0)**
Carollia perspicillata (Linnaeus, 1758)	3			1	7	3	7	2	9		**32 (9.2)**
Glossophaga soricina (Pallas, 1766)	1	1		1	4		9				**16 (4.6)**
Anoura caudifer (É. Geoffroy, 1818)			2		25	1	4		15		**47 (13.5)**
Anoura geoffroyi Gray, 1838	1					2	1				**4 (1.1)**
Desmodus rotundus (É. Geoffroy, 1810)	2						3		9		**14 (4.0)**
Diphylla ecaudata Spix, 1823			2			2	1		7		**12 (3.4)**
Family Vespertilionidae											
Myotis albescens (É. Geoffroy, 1806)		1								4	**5 (1.4)**
Myotis nigricans (Schinz, 1821)		1	1		1	1		1	1	1	**7 (2.0)**
Histiotus velatus (I. Geoffroy, 1824)									1		**1 (0.3)**
Family Molossidae											
Molossops neglectus Williams and Genoways, 1980					1						**1 (0.3)**
Total Species/area	**8**	**5**	**7**	**7**	**9**	**9**	**10**	**5**	**10**	**3**	**348 (100)**

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APPENDIX 1. Voucher list.

Mimon bennettii: (1475); *Micronycteris megalotis*: (1488); *Artibeus fimbriatus*: (1471, 1476, 1480, 1487); *Artibeus lituratus*: (1477, 1489, 1490); *Pygoderma bilabiatum*: (1467); *Platyrrhinus lineatus*: (1494); *Sturnira lilium*: (1465, 1469, 1473, 1479); *Carollia perspicillata*: (1464, 1474, 1481, 1493); *Glossophaga soricina*: (1468, 1486, 1497); *Anoura caudifer*: (1478, 1484, 1498); *Anoura geoffroyi*: (1483, 1496); *Desmodus rotundus*: (1466, 1485); *Diphylla ecaudata*: (1482, 1491); *Myotis albescens*: (1472); *Myotis nigricans*: (1470, 1495); *Molossops neglectus*: (1492).